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Contents of digital literacy from the perspective of teachers and pupils

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Abstract

This paper deals with the contents of digital literacy education on the primary and lower secondary schools from the perspective of teachers and pupils. It is based on the results of a relatively large exploratory survey, which involved more than thousand schools. This project aimed to improve specification of curriculum, processes and organizational aspects of students' digital competence development and to determine the current state, structure and orientation of development of digital literacy in primary and lower secondary schools. This paper analyses selected results of this research project and concerns the content and concept of informatics subjects in primary and lower-secondary school and their evaluation by teachers and pupils.

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Keywords: school education; digital competence; digital literacy

1. Introduction

The interpretation of the concept of digital competencies and digital literacy has undergone long-term development and its contemporary appearance is characterized by complexity and by focuses not only on technology skills but also cognitive and attitudinal components of personality.

The development of digital competence, whether implemented in primary school, in other forms of initial education, or even further education, is targeted at the entity of the respective educational impact and the corresponding level of digital literacy. Generally speaking, competencies are understood to be an integrated, portable and multifunctional set of knowledge, cognitive and practical skills, attitudes and values representing the potential to perform effectively in a given context, which can be utilized as a whole to enable efficient conduct of a given individual (OECD DeSeCo, 2005).

Building on the explicit incorporation of Digital Competence among key competencies for lifelong learning (European Parliament and the Council, 2006) and its characteristics, additional research activities which focused on

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more precise specifications of a given competency and its components were also conducted. Undoubtedly, one of the most significant of these studies was the Digital Competence Project (DIGCOMP), which was carried out by the Institute for Prospective Technological Studies in Spain an institute of the European Commission - Joint Research Center (Ferrari, 2013). The DIGCOMP project was based on the understanding of key competencies such as the ability to use relevant knowledge and skills with responsibility and autonomy, while utilizing a creative, critical and intercultural approach in relation to work, leisure and education (Ala-Mutka, 2011; Ferrari, 2012).

A report from the DIGCOMP project presented a general framework for relevant key competencies and their related sub-competencies. More specifically, it presented the following 5 areas and 21 sub-competencies that characterize skills and attitudes in terms of necessary knowledge (Ferrari, 2013):

1. Information: 1.1 Browsing, searching and filtering information; 1.2 Evaluating Information; 1.3 Storing and retrieving information.
2. Communication: 2.1 Interacting through technologies; 2.2 Sharing information and content; 2.3 Engaging in online citizenship; 2.4 Collaborating through digital channels; 2.5 Netiquette; 2.6 Managing digital identity.
3. Content creation: 3.1 Developing content; 3.2 Integrating and re-elaborating; 3.3 Copyright and Licences; 3.4 Programming.
4. Safety: 4.1 Protecting devices; 4.2 Protecting personal data; 4.3 Protecting health; 4.4 Protecting the environment.
5. Problem solving: 5.1 Solving technical problems; 5.2 Identifying needs and technological responses; 5.3 Innovative and creative use of technology; 5.4 Identifying digital competence gaps.

In terms of digital literacy, the latest and most comprehensive conceptual requirements (i.e. necessary knowledge, skills and attitudes that students should acquire) identified by the DIGCOMP project include the following 21 subareal competencies (Ferrari, 2013): Browsing, searching and filtering information; Evaluating Information; Storing and retrieving information; Interacting through technologies; Sharing information and content; Engaging in online citizenship; Collaborating through digital channels; Netiquette; Managing digital identity; Developing content; Integrating and re-elaborating; Copyright and Licences; Programming; Protecting devices; Protecting personal data; Protecting health; Protecting the environment; Solving technical problems; Identifying needs and technological responses; Innovative and creative use of technology; Identifying digital competence gaps.

2. Aims and methods of the research

The development of digital literacy of children in schools focused research project Czech Science Foundation Children's information technology competencies and their development at primary and lower-secondary schools, which was carried out at the workplace of the petitioners of this project. The research focused on the issue of informatics education at primary and lower-secondary schools in the Czech Republic and its target group consisted of teachers of informatics subjects, and their pupils.

The main objective of the project was to recognize the current state, structure and orientation (in terms of aspects pertaining to curriculum, processes and organization) of digital competence development in children (i.e. building relevant levels of digital literacy in formal education), and identify key features and processes of digital competence development in schools and contribute to improvements in the quality education in an information society – especially the process of digital competence development in children in schools, which will have an impact on the labor market, effective lifelong learning, and life success in a given developmental stage of an information society.

The subject of research was broken down into five areas which focused on the: (a) characteristics of informatics learning activities, (b) content of informatics learning activities, (c) current state and concept of pupils' information technology competencies development, (d) structure of teachers' ICT competencies, and (e) implementation of information technology competencies development into learning activities and educational school environment (Štípek, Rambousek & Procházka, 2013a).

In addition to theoretical methods employed during an extensive exploratory survey, the project also used empirical methods of a quantitative and qualitative nature. The questionnaire method was used as a primary empirical research method and it was based on an interactive graphic questionnaire for teachers of informatics

subjects. In addition to this, a questionnaire for pupils was distributed and was completed by pupils from primary and lower-secondary schools. The final empirical method constituted a survey method and case-study method (Štípek, Rambousek & Procházka, 2013b).

3. Selected findings

Selected research findings fall within the second area of research. They concern the content and concept of informatics subjects in primary and lower-secondary school and their evaluation by teachers and pupils. In order to obtain the data, we employed a questionnaire method as primary research method. For further findings we employed other above mentioned methods.

3.1. Respondents

The sample of teachers consisted of 1,183 teachers of compulsory informatics or ICT-orientated subjects representing 1,064 primary and lower secondary schools. It comprised 46% of men and 54% of women. There was a very even geographical distribution of the respondents and it corresponded quite accurately with the overall distribution of primary and lower secondary schools in the Czech Republic, both in terms of the number of schools representing a particular region from the viewpoint of the size of the location where the respondents' schools were located, and in terms of the size of the respondents' schools. As regards pupils, the sample consisted of 2,173 lower secondary school pupils from 112 primary and lower secondary schools. It comprised 48% of girls and 52% of boys. The distribution of respondents across the grades ranged from 20% to 30%, sixth grade 28%, seventh grade 29%, eighth 20%, and ninth grade 23% (Černochová et al, 2013; Rambousek & Štípek, 2014).

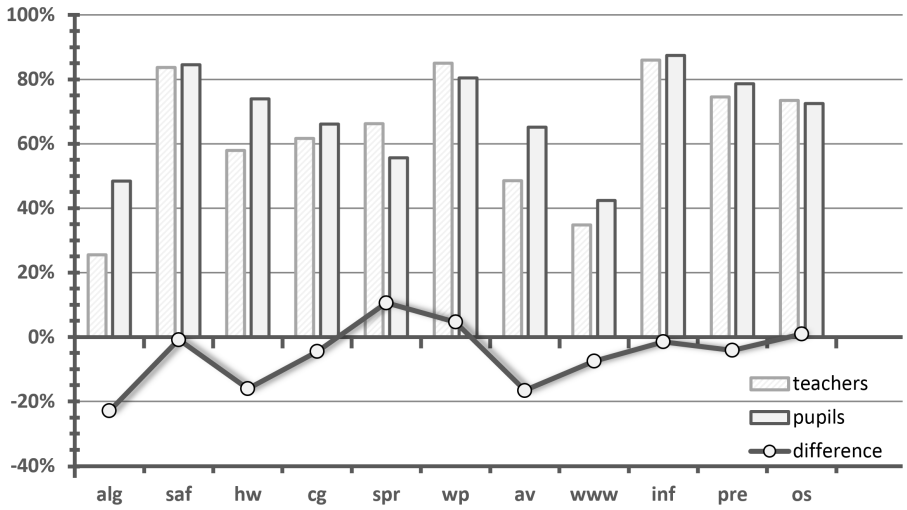
In terms of comparing pupils' and teachers' statements, the questionnaire items provided a sufficient amount of data for comparing roughly 75% of items concerning the content and concept of informatics subjects. It concerned the following thematic units (the abbreviations as used in the graphs are in brackets):

- Algorithm design and programming – developing algorithmic thinking (alg)
- Safety on the internet, copyright, ethical principles (saf)
- PC hardware and software – the structure and functions of computers (hw)
- Computer graphics – editing and creating graphics (cg)
- Working with spreadsheets – processing data, creating tables and graphs (spr)
- Word processing – creating and editing documents, basics of typography (wp)
- Audio and video on the computer – using and producing multimedia (av)
- Creating and publishing websites (HTML, CSS, PHP, etc.) (www)
- Searching for and retrieving information from the internet, data collecting (inf)
- Creating and using presentations – working with presentation applications (pre)
- Basic user skills, working in an operating system, file management (os)

Both pupils and teachers commented on the content and concept of informatics subjects from a number of viewpoints. Three of them considered by the research team as the most important will be introduced in this paper. Significance, i.e. the importance of the thematic units, was the first viewpoint. The next one was difficulty of mastering thematic units, and the third one attractiveness (popularity). Significance and difficulty were evaluated by teachers in relation to their pupils, thus how significant the topic is for pupils' digital literacy development and how difficult it is for them to master the topic. Pupils then evaluated the same aspects in relation to themselves. Popularity was assessed differently. Teachers commented on the fact how attractive it is for them to teach particular topic. Pupils commented on whether they enjoy the topic or not.

3.2. Significance of thematic units

Respondents evaluated the significance of thematic units by moving the graphic slider on the scale of significance for each topic. The overall comparison of statements of both groups of respondents is shown in the overview graph, which converts results ("the significance rate") into percentage (Graph 1). At the same time, the bar graph shows the difference between both groups. On the horizontal axis, there are abbreviations of the thematic units.



Graph 1 Significance of thematic units

The following topics are considered by teachers as the most significant for the pupils' digital competencies development: "Searching for and retrieving information", "Safety on the internet, copyright, ethical principles", "Word processing". Pupils evaluate these three topics similarly. Even though the difference between pupils' and teachers' view is statistically significant (at the significance level of 5%), the difference in their views can be seen as very small given the size of both groups. Similar congruence in above average significance occurred in the following topics: "Creating and using presentations", "Basic user skills and file management". These five thematic units appear also in the other part of research where they were identified by teachers as key topics for the development of primary and lower-secondary school pupils' digital competencies (Štípek & Vaňková, 2014). Thus teachers' evaluation of their significance is not surprising in the given context and teachers' attitude is consistent. Pupils' attitude towards the importance of the thematic units was the focus of interviews with teachers and discussions with pupils. It became apparent that the perception of significance reflects the way it is perceived by other people, or society. It is interesting that "Safety on the internet, copyright, ethical principles", which belonged to marginal topics 10 years ago (Rambousek et al, 2007), holds a strong position in most schools and it is also accepted by pupils this way.

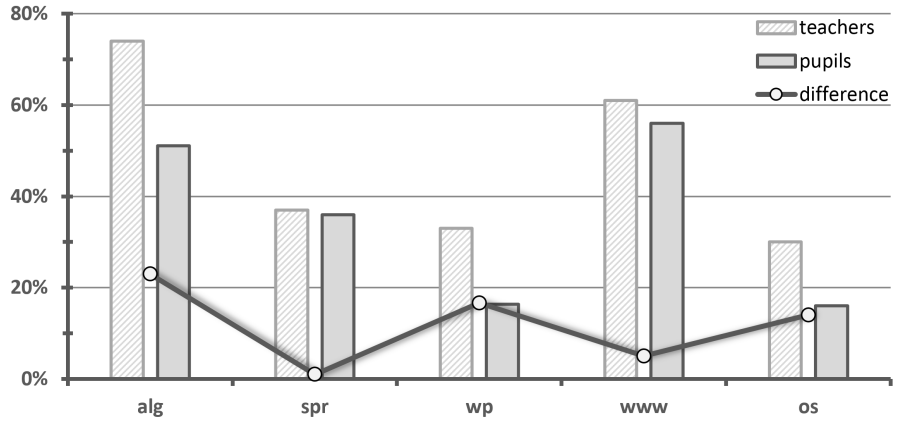
The following thematic units showed the biggest differences in teachers' and pupils' attitudes: "Algorithm design and programming – developing algorithmic thinking", "PC hardware and software – the structure and functions of computers", "Audio and video on the computer – using and producing multimedia", and "Working with spreadsheets – processing data, creating tables and graphs" and the difference in attitudes for each topic is caused by other factors. As regards "Algorithm design and programming – developing algorithmic thinking", "PC hardware

and software – the structure and functions of computers", the research team takes the view that the reason lies primarily in the above mentioned specific character of selected pupils, who perceive information technology education closer to informatics whereas among teachers the relationship to informatics is weakened in favour of user approach, or seeing ICT as a user's tool (Černochová et al, 2013). The current situation in education plays its role here as well and also teachers' readiness to teach informatics subjects. The research also showed that two fifths of teachers of informatics subjects see their own digital competencies at the level, which they themselves consider as minimum acceptable for teaching informatics subjects in primary and lower-secondary school. One fifth of teachers admit that their competencies do not even reach the minimum acceptable level. This condition can be observed particularly in the areas such as programming, databases, creating www pages or hardware (Rambousek, Štípek, Procházka & Wildová, 2014; Štípek & Vaňková, 2014).

Based on the findings, we were not able to clarify a higher significance level attributed by pupils to "Audio and video on the computer – using and producing multimedia". There might be a connection with the popularity of multimedia in the life of youth. On the contrary, to analyse the topic "Working with spreadsheets – processing data, creating tables and graphs", which is one of the essential parts of the content of compulsory informatics subjects in most schools, we collected a number of data and pupils' and teachers' statements. Pupils' evaluation of the significance reflects also popularity apart from the already mentioned influence by peers and society. "Working with spreadsheets – processing data, creating tables and graphs" was the only unit that showed link (statistically significant at the level of 5%) between popularity and the evaluation of significance. Pupils, who expressed a higher level of attractiveness, attached more often greater importance. As regards teachers, the research showed that those who attached greater importance explained their evaluation by a reference to the need of reflection of societal demands, or the labour market.

3.3. The difficulty of thematic units

For both groups of respondents (teachers, pupils) the difficulty aspect focused on pupils. Based on their own experience, teachers thus commented on how difficult the thematic unit was for their pupils whereas the pupils' task was to say how difficult it was for them personally to master the given topic. Respondents expressed their views on difficulty of the given thematic units in a similar way to significance. Yet, due to certain content differences in questionnaire sub-questions, it was possible to compare difficulty only for five thematic units from the above cited list. For "Basic user skills, working in an operating system, file management" we could analyse only the sub-topic "File management". The results of comparison are again summarised in the graph, which converts results into the relative scale and the bar graph demonstrates the differences between both groups (Graph 2).



Graph 2 Difficulty of thematic units

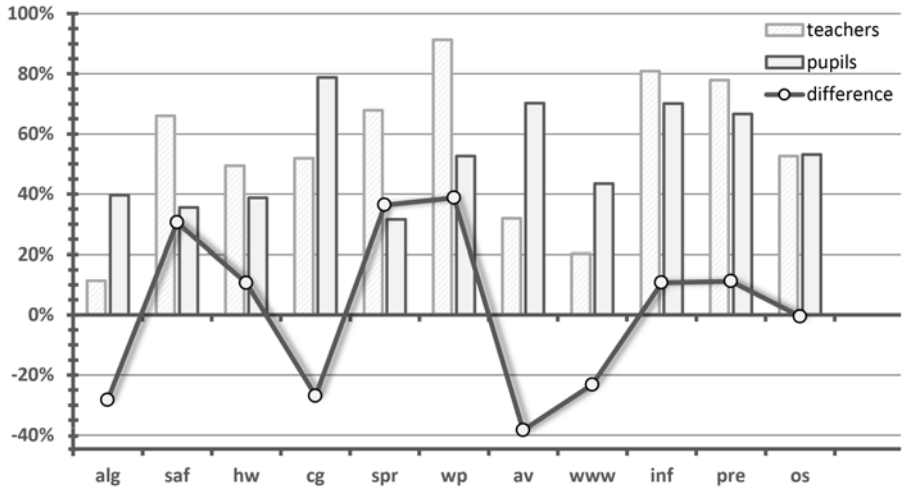
Both groups of respondents evaluate the following topics in terms of difficulty practically identically: “Creating and publishing websites (HTML, CSS, PHP, etc.)” and “Working with spreadsheets – processing data, creating tables and graphs”. The results for the former topic need to be seen as tentative taking into consideration a number of tools currently available resulting in completely different approaches and methods of creating websites and hence their difficulty. On one hand there are tools that do not place bigger demands on users than on pre-intermediate ICT users. On the other, there are approaches and technologies requiring competencies of an experienced programmer.

As far as the differences are concerned, we need to consider the whole spectrum of approaches to the thematic units, which we can encounter in schools. This applies in particular to “Algorithm design and programming - enveloping algorithmic thinking”, which ranges from a “classic” approach - programming in selected programming language, to environment combining programming language and graphic symbols or objects representing sub-algorithm, by means of which the final programme is ”put together”, or graphical programming environment developed for children, in which algorithm is build up from “a jigsaw puzzle”.

At first sight the results of “Word processing – creating and editing documents, basics of typography” may appear as surprising. The teachers’ questionnaire, discussions with pupils and interviews with teachers showed that the difference consists in the fact that unlike teachers, pupils attach less importance to certain aspects of word processing. Pupils primarily focused on the difficulty of mastering the application and they paid only a slight attention to an electronic text (typography etc.) whereas teachers considered both parts.

3.4. Attractiveness of thematic units

The aspect of attractiveness was approached differently compared to significance and difficulty, for which both groups evaluated the same thing (teachers evaluated significance and difficulty in relation to pupils). Now teachers expressed their preferences in the thematic units, such as the content of the subjects they teach, namely whether they want or do not want to teach the topic. Pupils then commented on whether the topic is attractive for them or not. Both groups made their choices in the same type of environment by moving the iconic symbol for the topic into the box marked as positive or negative. The results of both groups are again summarised in the combined graph, which converts results into a relative scale, and the bar graph demonstrating the difference between both groups (Graph 3).



Graph 3 Attractiveness of thematic units

The graph should be viewed as summarising rather than strictly comparative since the attractiveness of the topic is a different category for pupils (they perceive it as "entertainment) compared to teacher's preferences in teaching the topic. The latter can comprise various motives, such as easy lesson planning, a topic appropriate to teacher's own digital competencies or presumption of easy implementation into teaching.

The graph shows that for most topics teachers' and pupils' preferences are different. This finding might lead to a conclusion that informatics subjects are unappealing either to teachers or pupils. Nevertheless, such a view is simplistic because in most schools some topics with different preferences are paid only a slight or no attention to. On the contrary there are topics, for which the preferences were identical, and teachers spend an above-average amount of time teaching them. The attractiveness of the whole subject must be thus considered along with the time allocated to the thematic sub-units and the proportion of schools having the subject as part of the content of the compulsory subject.

To find out which thematic units are taught in schools and how much time is allocated to them, two questions in the teachers' questionnaire were employed (Černochová et al, 2013). However, we could identify the time from the obtained data only roughly. The findings show that the most often taught topics are the following: "Word processing – creating and editing documents, basics of typography" (98% of schools, above average time in 95% of schools), "Safety on the internet, copyright, ethical principles" (97%, above average time in 63% of school), "Searching for and retrieving information from the internet, data collecting" (95%, above average time in 73% of schools), "Creating and using presentations – working with presentation applications" (90%, above average time in 63% of schools), "PC hardware and software – the structure and functions of computers" (90%, above average time in 27% of schools), "Working with spreadsheets – processing data, creating tables and graphs" (85%, above average time in 56% of schools), and "Basic user skills, working in an operating system, file management" (81%, above average time in 43% of schools).

Regarding the thematic units occurring in schools and their time allocation, in terms of differing attractiveness, the following topics are significant: "Safety on the internet, copyright, ethical principles", "Computer graphics – editing and creating graphics", "Working with spreadsheets – processing data, creating tables and graphs" and "Word processing – creating and editing documents, basics of typography", and "Audio and video on the computer – using and producing multimedia".

The attractiveness of the units concerning computer graphics, sound and video was not surprising. Pupils are familiar with these areas of ICT, which are taught practically in schools. The areas allow for creativity and imagination, the content and outcomes of the activities take form attractive by itself. Pupils' additional statements (expressing their views through creating a longer answer) also show that they generally prefer practical work with various applications. Significantly lower popularity with teachers may, on the contrary, seem surprising since the topic, which is appealing to pupils, could be attractive for teachers as regards lesson planning and realisation, e.g. in terms of pupils' motivation. What is reflected here are significant specificities of the current condition as to the provision of compulsory informatics subjects in primary and lower-secondary schools, which cannot be found in other areas or subjects. They concern in particular the teachers' readiness to teach informatics subjects. Given the above mentioned statement that more than one fifth of teachers do not consider their own digital competencies as sufficient for teaching informatics subjects in primary and lower-secondary schools (yet they teach it), teachers' competencies in the field of graphics and multimedia belong to those they lack. In other words, a declining level of teachers' digital competencies does not mean a steady decline in teachers' level of digital competencies in all thematic topics but only in some of them. In this context it should be added that only 18% of respondents indicated that they have appropriate teacher training and qualification in teaching informatics subjects in primary and lower-secondary schools, 22% of them indicated mathematics. (Rambousek, Štípek & Wildová, 2015).

The topics such as "Working with spreadsheets – processing data, creating tables and graphs" and "Word processing – creating and editing documents, basics of typography" showed on the contrary greater attractiveness for teachers and we may conclude that both topics belong into the first five thematic units teachers enjoy teaching most with "Word processing – creating and editing documents, basics of typography" occupying first place in this

respect. Those are topics, which are nowadays seen as part of basic user skills and they belong to standard equipment in teachers' portfolio, which practically all teachers regardless of their overall level of digital competencies possess. Of non-negligible importance is the fact that these topics have been part of informatics subjects since the beginning of its implementation into primary and lower-secondary schools and that teachers use office applications also outside school. For a number of teachers, particularly the ones without certificate official study for the subject and those less skilful in ICT, the preferences for teaching topics linked to office software are natural. The pupils' statements indicate that if the texts they work with and figures concern the phenomena they are interested in (music, film etc.), then they give the attractiveness of those topics a higher evaluation. The analysis also proved a connection (at the significance level of 0.1%) between attractiveness and difficulty of thematic units. Pupils, who evaluated the topic as attractive, perceive that topic as less difficult and vice versa. Contingency coefficient C for "Working with spreadsheets – processing data, creating tables and graphs" reached the value of 0.34 and for "Word processing – creating and editing documents, basics of typography" 0.29. Yet it is necessary to emphasise that the proven connection does not mean that the perceived attractiveness effected pupils' evaluation of difficulty.

The analyses of other pupils' statements, namely their comments on informatics subjects, indicated that what pupils dislike most is working with office applications (18%), in particular with spreadsheets (8%). In connection with working with word processing and issues of safety, ethical principles and copyright, 16% of pupils perceive its low difficulty or even boredom as a con.

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